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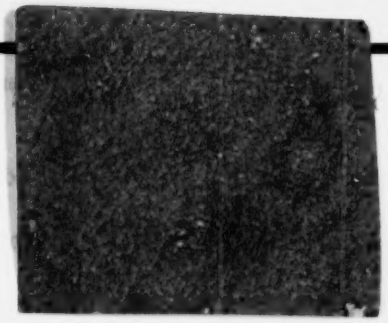

# EXAMINATION OF THE PHYSICAL NATURE AND TECHNICAL ATTRIBUTES OF THE GEOSTATIONARY ORBIT; EXAMINATION OF ITS UTILIZATION AND APPLICATIONS, INCLUDING, INTER ALIA, IN THE FIELD OF SPACE COMMUNICATIONS, AS WELL AS OTHER QUESTIONS RELATING TO SPACE COMMUNICATIONS DEVELOPMENTS, TAKING PARTICULAR ACCOUNT OF THE NEEDS AND INTERESTS OF DEVELOPING COUNTRIES

**Working paper submitted by the Czech Republic**

## *Introduction*

The discussions conducted during the fortieth session of the Committee on the Peaceful Uses of Outer Space have shown that further progress in the item on the geostationary orbit might be assisted by a common understanding of the physical nature and technical attributes of the geostationary orbit.

The geostationary satellite orbit is a complicated phenomenon of the dynamical system of the Earth. It involves natural forces acting on the geostationary satellite, as well as man-made impulses counteracting natural perturbative forces which remove the geostationary satellite from its nominal position.

Discussions of the equitable access to, and use of, the orbit can reach universally acceptable solutions only if they are, explicitly or implicitly, based on established scientific and technical facts and if they respect existing physical constraints.

The present paper is an attempt to find brief consensus statements on important features of the geostationary orbit with a view to facilitating discussions in the Committee and its subcommittees.

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## The dynamical system of the Earth

The gravitational attraction generated by the entire body of the Earth is the main natural force acting on artificial Earth satellites. It acts on all satellites in the vicinity of the Earth without exception, up to a distance that exceeds the distance of the Moon.

Consequently:

*The existence of orbits of all satellites, including the geostationary satellites, depends mainly on gravitational phenomenc generated by the entire body of the Earth.*

In addition, minor gravitational forces affect and significantly modify orbits of artificial satellites. Of importance, for geostationary satellites, are:

- The gravitational attraction of the Sun and the Moon, called lunisolar perturbations,
- Perturbations caused by the oblateness of the Earth,
- Perturbations caused by the ellipticity of the Earth's equator.

In addition, minor non-gravitational forces affect and modify orbits of artificial satellites. Of importance for geostationary satellites is:

- The radiation pressure of the Sun, which generates relatively small deviations of the geostationary satellite from its orbit under gravitational forces.

## The geostationary orbit

According to the Radio Regulations of the International Telecommunication Union, the geostationary obit is the orbit on which a satellite should be placed to be a geostationary satellite. Its circular orbit lies in the plane of the Earth's equator. The satellite turns about the polar axis of the Earth in the same direction and with the same period as those of the Earth's rotation.

The geostationary orbit is situated at a distance of 42,165 kilometres from the centre of the Earth. The satellite can be observed from, and provide telecommunication services to, all points on the surface of the Earth if it is at least 5 degrees to 10 degrees above the horizon.

If the geostationary satellite is left to natural forces, it will not stay fixed in the geostationary orbit. Lunisolar perturbations, together with perturbations caused by the oblateness of the Earth, will remove it gradually from the equatorial plane, initially at a rate of 0.85 degrees per year. If viewed from the ground, the satellite will not appear stationary, but will describe in the sky a figure "eight". That figure will have an amplitude of about 3.4 kilometres the first day, over 100 kilometres in a month and 1,250 kilometres after one year.

The perturbations caused by the ellipticity of the Earth's equator move the satellite in longitude around one of the stable points at approximately 105 degrees east and 75 degrees west. Small movements in longitude are caused also by the radiation pressure of the Sun.

If the satellite has to be kept close to its nominal position, all its perturbative motions have to be corrected by occasional man-made impulses called "station-keeping".

Consequently:

*A geostationary satellite, if acted upon either by natural forces or by man-made impulses, is not fixed over a point on the Earth's equator. Between corrective impulses of its station-keeping, it is in a natural flight caused by gravitational as well as non-gravitational forces generated by the Earth, the Sun and the Moon.*

**Conclusion**

The discussions on the geostationary orbit will be significantly facilitated if the Scientific and Technical Subcommittee reaches consensus on the two statements in italics above and if those statements are considered as the agreed opinion of the Subcommittee.